Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Reallocation of the 216-220 MHz,	)	WT Docket No. 02-08
1390-1395 MHz, 1427-1429 MHz,	)	RM-9267
1429-1432 MHz, 1432-1435 MHz,	)	RM-9692
1670-1675 MHz, and 2385-2390 MHz	)	RM-9797
Government Transfer Bands	)	RM-9854
	)	RM-9882

To: The Commission

COMMENTS OF AEROSPACE AND FLIGHT TEST
RADIO COORDINATING COUNCIL

Aerospace and Flight Test Radio Coordinating Council ("AFTRCC"), by its counsel, hereby submits its comments in response to the Commission's *Notice of Proposed Rule Making* in the above-captioned proceeding (the "*NPRM*"), FCC 02-15, released February 6, 2002. In the NPRM the Commission proposes service rules for the 27 megahertz of spectrum transferred from Government to non-Government use pursuant to the Omnibus Budget Reconciliation Act of 1993 ("OBRA-93") and the Balanced Budget Act of 1997 ("BBA-97").[1]

AFTRCC focuses these comments on the issue of interference protection with respect to in-band and out-of-band emissions in the 2385-2390 MHz and 1432-1435 MHz bands, and on

[1] *See Reallocation of the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands (Report and Order and Memorandum Opinion and Order)*, ET Docket No. 00-221, FCC 01-382, released January 2, 2002 (hereafter "*Reallocation Report and Order*").

coordination procedures to provide necessary protection to the non-Government and Government flight test sites for which the Commission has required protection until 2007.[2]

INTRODUCTION

AFTRCC is an association of aerospace companies engaged in the design, development, manufacture and testing of commercial and military aircraft, space vehicles, missiles and weapons systems. Members of AFTRCC include, in particular, the major U.S. manufacturers of military and commercial aircraft. AFTRCC is the FCC-recognized advisory committee for coordination of flight test frequencies shared by Government and non-Government users. *See* 47 C.F.R. Section 87.305. AFTRCC works closely with its counterpart Government coordinators in order to ensure prompt, efficient coordination of the flight test frequencies.

AFTRCC has a long history of participation in spectrum policy issues relative to flight test telemetry and voice frequencies. For example, AFTRCC initiated the private sector efforts which led to the allocation of radio spectrum for aeronautical telemetry, including its 1975 initiative which culminated with the allocation of the 1435-1525 MHz band for flight testing. Similarly, AFTRCC successfully petitioned for regulatory changes which eliminated potential regulatory handicaps to the global competitiveness of the U.S. commercial space launch industry. AFTRCC also has represented the aerospace industry in connection with proposals which have contemplated reallocation of U.S. flight test spectrum to other, non-aviation uses -- such as the early proposal to reallocate the 1452-1492 MHz band for DARS. AFTRCC's experience thus makes it especially well qualified to comment on matters affecting flight test spectrum.

[2] *See Reallocation Report and Order* at para. 71.

Aeronautical telemetry is used to provide critical operational and telecommand data between ground facilities and the aircraft, space vehicle, missile or weapon system under test. Besides the 1435-1525 MHz band, non-Government flight test telemetry is transmitted using the band 2360-2385 MHz (and until January 1, 2007 at a number of sites, up to 2390 MHz).

Flight test communications are critical to U.S. industry's ability to develop and deliver as efficiently as possible aircraft, space vehicles and military equipment. Moreover, flight test telemetry performs a critical safety function: The telemetry link enables ground-based engineers to monitor in real time conditions aboard the aircraft so as to detect and avert possible threats to the life of the pilot, to neighboring communities, or to the tremendous investment in one-of-a-kind prototype aircraft.

DISCUSSION

Interference Considerations. The Commission has requested comment on technical restrictions for control of in-band and out-of-band interference.[3] This issue is particularly germane to AFTRCC as its members operate aeronautical telemetry facilities on frequencies adjacent to the 1432-1435 MHz transfer band, and within and adjacent to the 2385-2390 MHz transfer band.

Insofar as in-band (2385-2390 MHz) interference to flight testing is concerned, non-Government (and Government) flight testing will continue in the band until January 1, 2005, and at 19 additional sites until January 1, 2007.[4] This latter group will be protected against in-band

[3] *NPRM* at paras. 98-106.

[4] AFTRCC also conducts flight test operations at several of the Government sites listed in footnote US363(b) in addition to the nine AFTRCC sites listed in footnote US363(c).

interference by virtue of the protection radii recommended by AFTRCC and NTIA, respectively, around each of the designated locations.[5]

Out-of-band (*i.e.*, adjacent band) interference to flight testing is another matter. Such interference could emanate from operators in the 1432-1435 MHz band (or even below) or from operators in the 2385-2390 MHz band, and affect flight test telemetry in the 1435-1525 MHz ("L") or 2360-2385 MHz ("S") bands, respectively.

Flight test operations are characterized by a combination of weak signals, wide bandwidths (5 MHz and potentially higher), and high-gain ground receiving antennas. Test aircraft use transmitters with output power levels of 20 watts and less, and operate at ranges up to 200 miles from the telemetry ground stations. Services operating in adjacent transferred bands could have effective output levels orders of magnitude greater than aeronautical telemetry transmitters. This issue has arisen in other contexts, including the recently proposed terrestrial repeaters in the 1525-1559 MHz Mobile Satellite Service band immediately adjacent to the 1435-1525 MHz flight test band.[6]

There are any number of variables that can affect the potential of a new service to cause interference to telemetry operations, including antenna power and height, transmitter characteristics, the specific operating frequencies of the potentially interfering signal and intervening terrain. Rather than attempting to prescribe these levels for new services in the

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[5] *See* footnote US363 to Section 2.106.

[6] *See generally Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band and the 1.6-2.4 GHz Band; Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile Satellite Service,* IB Docket No. 01-185, ET Docket No. 95-18, FCC 01-225, released August 17, 2001; *see also* Comments of the Aerospace and Flight Test Radio Coordinating Council, filed October 19, 2001.

transferred bands, it is more appropriate to define telemetry's protection in terms of the power flux density at the telemetry receive site.

Attached hereto is the statement of Daniel G. Jablonski, PhD., of the Johns Hopkins Applied Physics Laboratory which discusses the minimum power flux density levels that can exist at a telemetry receive site without causing interference. Based on this analysis, flight test telemetry requires a protection level of at least -181 dBW/m^2/4 kHz as against operations at 2385-2390 MHz (to avoid interference to telemetry in the 2360-2390 MHz band) and at 1432-1435 MHz (to avoid interference with telemetry in the 1435-1525 MHz band). This level represents an aggregate limit for all potentially interfering sources within the respective bands and demonstrates the highly sensitive nature of telemetry equipment and the need for an effective coordination process. Use of this pfd level in combination with the coordination procedures described below should provide adequate protection for this safety-related service.

Coordination with AFTRCC Flight Test Sites. In the *Reallocation Report and Order* the Commission established a coordination requirement for any operations in the 2385-2390 MHz band through January 1, 2007, using a distance trigger; *i.e.*, any station within the protection radii in footnote US363 must receive prior coordination.[7] Specifically, the instant *NPRM* includes draft rules that require coordination by any licensee or applicant in the new 2385-2390 MHz Radio Service proposing fixed sites or mobile operations within the applicable protection radii of the specified Government and non-Government sites before the station is activated.[8]

The Commission does not, however, address the issue of coordination for operations in bands adjacent to aeronautical telemetry which, as discussed above, also can cause detrimental interference to flight testing. This applies to the 1432-1435 MHz band (adjacent to 1435-1525

[7] *See Reallocation Report and Order* at para. 71.

[8] *NPRM* at paras. 137-138 and proposed rule Section 27.903(b).

MHz flight test operations). It also applies to 2385-2390 MHz (adjacent to 2360-2385 MHz for flight testing).

In particular, the coordination requirement should apply to the new operations at 1432-1435 MHz and at 2385-2390 MHz. The same distance threshold as AFTRCC and NTIA recommended, and the Commission adopted, for 2385-2390 MHz operations through January 1, 2007, should be applied to these adjacent band cases. Dr. Jablonski demonstrates in the attached statement that applying the same distance trigger for coordination of adjacent band operations will provide the necessary protection to prevent interference to aeronautical telemetry operations.[9]

Because the key issue to resolve once the coordination process has been initiated is interfering signal strength at the telemetry receive site, the coordination notice provided to AFTRCC (or FAS for the Government sites) should include a showing as to the aggregate power flux density at the telemetry receive site.[10] The geographic coordinates of each of the protected telemetry sites is provided in footnote US363. Thus, if a licensee proposed operating a fixed station or mobile facilities within the applicable protection radii set forth in footnote US363, it would need to make a showing of the aggregate power flux density from its proposed operation at the coordinates of the applicable flight test ground station.

A word also is in order regarding the coordination process. The Commission suggests that applicants prepare and file their applications with the agency "containing all the technical

[9] This presumes that the potentially interfering operations are terrestrial-only. The protection radius is not effective to protect flight test telemetry in the case of aeronautical operations. While such operations are precluded at 1432-1435 MHz (*see* NPRM at para. 10), they have not been precluded at 2385-2390 MHz. The Commission should proscribe aeronautical mobile operations in 2385-2390 MHz other than flight test telemetry in this proceeding.

[10] A similar requirement as to the Government sites listed in footnote US363 also would be appropriate.

information about the proposed operation."[11] Only at that point would coordination be requested of AFTRCC, a request to be made by the Commission.[12]

This represents a significant departure from coordination procedures in most, if not all, other radio services -- including coordination for non-Government flight testing -- where the applicant first contacts the coordinator, and only then is an application submitted to the Commission. In the case of flight testing, prospective operators traditionally contact AFTRCC and secure a frequency recommendation. That recommendation then forms part of the application filed with the Commission. If any issues arise with respect to the proposal, AFTRCC and the applicant are in a position to resolve the problem before the applicant has gone to the time and trouble of filing an application "containing all the technical information" -- information which would have to be changed in the event coordination as proposed is not possible.

The Commission's proposal, by contrast, needlessly increases the burden on AFTRCC, on applicants, and even on the Commission itself, and would inevitably slow the application process. This is particularly the case since any changes in the proposed parameters resulting from the coordination process would require the applicant to submit an amendment or perhaps even a new application (requiring a second application fee). Accordingly, the Commission

[11] *NPRM* at para.138.

[12] *Id*. at para. 138. Although the Commission proposes geographic service area licenses for the 2385-2390 MHz and 1432-1435 MHz services, proposed Rule 27.903(b) makes clear that, with respect to 2385-2390 MHz, any station within the protection radii in footnote US363 will require an individual station license prior to construction or operation. In other words, the geographic area licensee will be required to coordinate those of its stations which would fall within the protection zone, notwithstanding the fact that it may have a wide-area license. A similar provision is required in Section 27.703 for the 1.4 GHz service before any station within the 1432-1435 MHz band is constructed or operated. This is a critical component of an effective coordination process. Absent such requirement, no adequate enforcement mechanism would exist to assure that facilities requiring coordination are, in fact, coordinated.

should apply the current coordination procedures to new services in the 2385-2390 MHz and 1432-1435 MHz bands.

CONCLUSION

AFTRCC's members use the 2360-2390 MHz and 1435-1525 MHz bands for flight test, telemetry and telecommand operations vital to the U.S. aerospace industry's ability to produce safe, efficient and effective commercial and military aircraft, space vehicles and weapons systems. They also are critical for maintaining safety of life and property. It is therefore essential that any new services operating in the 2385-2390 MHz and 1432-1435 MHz bands not interfere with these operations. The Commission's proposed rules address this concern only as to co-channel flight test operations in the 2385-2390 MHz band and only until January 1, 2007. It is necessary to extend this protection to the 1435-1525 MHz band (as against new 1432-1435 MHz licensees) as well as 2360-2385 MHz (as against new 2385-2390 MHz licensees). Prior coordination of new operations in these bands, combined with the pfd showing recommended herein, is the most efficient way to protect flight testing and resolve expeditiously any coordination issues.

Respectfully submitted,

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Analysis of Interoperability of L and S Band Terrestrial Transmitters with Flight Test Telemetry Systems

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Background

The microwave spectrum from 1435 - 1525 MHz (the L band) and from 2360 - 2390 MHz (the S band) is allocated in the United States for flight test telemetry use. Of interest here are the allocations of 3 MHz in the adjacent band between 1432.0 and 1435.0 MHz, and 5 MHz in the sub-band 2385.0 - 2390.0 MHz. The terrestrial use of this spectrum can cause adjacent and/or co-channel interference to flight test operations.

The co-channel concern has already been addressed by the introduction of exclusion zones in the vicinity of a selected set of aeronautical flight test ground sites. In the absence of an exclusion zone, which is the case for the majority of flight test ground sites currently in use, and will eventually be the case for all ground test sites, the sub-band 2385 - 2390 MHz will not retain a primary allocation for flight test telemetry. However, the possibility of adjacent channel interference into the bands 1435 - 1525 MHz from emissions at 1432 - 1435 MHz, and into the band 2360 - 2385 MHz from emissions at 2385 - 2390 MHz, will still require careful consideration.

Telemetry signals affect the safety of flight, and are considered mission critical. Signals in the bands 1432 - 1435 MHz and 2385 - 2390 MHz are of concern because the equipment used for receiving the flight test telemetry signals is designed to accept, rather than reject, signals at these frequencies. This is because of the close proximity in frequency, and current and/or prior allocation of these frequencies as part of the flight test telemetry bands. The relative distances and power levels involved exacerbate the interference problem. Flight test aircraft utilize transmitters with output power levels of 20 watts and less, and operate at ranges of up to 200 miles from the telemetry ground stations. Terrestrial transmitters in these portions of the spectrum, on the other hand, can have effective output levels of hundreds of watts to over 10 kilowatts, with operation in close proximity to flight test ground stations.

The corresponding interference problem is not simple, and involves two key effects. First, the out-of-band emissions from the terrestrial transmitters can appear as in-band signals to flight test telemetry receivers. Second, the in-band (from the terrestrial operators' point of view) signals from the terrestrial transmitters can be sufficiently strong to overcome the telemetry receivers' out-of-band rejection capabilities.

There are multiple ways in which each of these effects can impact the operation of the flight test telemetry ground equipment. For example, the interfering emissions can saturate the wideband low noise amplifiers that are used as preamplifiers in almost all flight test ground stations. This is a fairly straightforward problem, as it is independent of many of the details of the flight test profile. The only concerns are whether the tracking antenna of the flight test ground station happens to point at one or more terrestrial transmit antennas, and whether the aggregate power received from these transmitters is sufficient to saturate the flight test preamp. This depends in part on the directive gain of the flight test telemetry receive antenna, which is not the same for all flight test ground stations.

Even if saturation does not occur, however, terrestrial emissions will be processed by the flight test receive equipment, and will degrade the signal to noise level of the desired telemetry signal from the flight test aircraft. This can reduce the maximum range from the ground station at which the aircraft can fly with acceptable telemetry system reliability and performance.

The flight test community expects that operators of terrestrial transmitters will be in compliance with the protection levels developed by AFTRCC and articulated in the ITU Recommendation ITU-R M.1459. Specifically, the combined out-of-band emissions from transmitters into the flight test bands should not exceed a level of -181 dBW/meter^2/4 kHz. Furthermore, the in-band emissions from these terrestrial transmitters should not saturate the preamps used at the receive antennas of flight test ground sites.

Recommendations

A protection radius of 160 kilometers will be adequate to prevent adjacent band interference to flight test activities, at both the L and S bands, under all but the most unusual circumstances. For adjacent channel operations within this 100 mile zone, notification and coordination will be needed to ensure compliance with the pfd protection levels defined in Recommendation ITU-R M.1459.

Also, it is essential that the IN-BAND emissions, in the bands adjacent to the flight test bands, do not cause saturation of the wideband, low-noise preamplifiers used by flight test ground stations. The power levels at which this will occur will depend on the particular antenna/preamplifier combinations in use at individual flight test ranges, and thus will require site-specific coordination.

Finally, the fixed radius coordination zone defined herein is predicated on the assumption that the sources of possible interference to flight test activities are terrestrial (fixed or mobile), rather than airborne transmitters.

I, Dr. Daniel G. Jablonski, am a technical staff member at the Johns Hopkins University Applied Physics Laboratory. To the best of my knowledge, the foregoing analysis is correct and complete.

My technical qualifications include Bachelor's and Master's degrees in electrical engineering from M.I.T. and a doctorate in physics from Cambridge University. I have over 20 years experience as a microwave engineer, with considerable experience in link budget analyses and the design of communications systems. I am a licensed professional engineer in the State of Maryland.

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